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PATENT ABSTRACTS OF JAPAN

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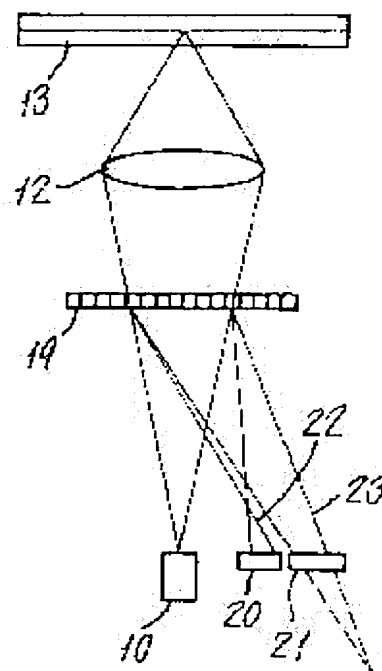
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(54) OPTICAL PICKUP DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To solve the problem that an offset or a deterioration of a focus error signal or a tracking error signal arises due to a movement of light convergence element with a tracking or a tilt of an optical information recording medium.

SOLUTION: A diffraction element 19 includes a diffraction region which is divided into a plurality of areas in the region supplementing at least a moving range of reflected light with the movement of the light convergence element 12. The diffraction element 19 and photodetectors 20 and 21 are disposed so that +1st order diffracted light generated in some areas of the plurality of areas converges on the front side of the photodetector 20 and that the +1st order diffracted light generated in some other areas of the plurality of areas converges on the rear side of the photodetector 21. The plurality of areas of the divided diffraction region are set so that the amount the converging diffracted light to the photodetector 20 is approximately equal to the amount of the converging diffracted light to the photodetector 21. A focus error signal is detected by a spot size detection method. A tracking error signal is detected by a push-pull method by dividing the photodetectors 20 and 21 into two with a division line which pass through about an optical axis of the diffracted light and which is parallel to the track direction of the optical information recording medium 13.



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CLAIMS

[Claim(s)]

[Claim 1]A light source.

Element condensing for condensing emitted light from this light source on an optical information recording medium, a photo detector which receives catoptric light from said optical information recording medium, and is changed into an electrical signal, and a diffraction element which diffracts catoptric light from said optical information recording medium, and is led to said photo detector.

Are the optical pickup device provided with the above, and said diffraction element has the diffraction region divided into two or more fields in a field with which a moving range of said catoptric light accompanying movement of said element condensing is compensated at least, While the primary [+] diffracted light produced in some two or more fields of said two or more fields condenses by a near side of said photo detector, said diffraction element and said photo detector, It is arranged so that the primary [+] diffracted light produced in some two or more fields of others of said two or more fields may condense by the backside of said photo detector, And two or more fields where it is not based on a position of said catoptric light in a diffraction region of said diffraction element, but light volume of the condensing diffracted light from said some of two or more fields to said photo detector and light volume of the condensing diffracted light from some two or more fields besides the above to said photo detector spread abbreviation etc. and where said diffraction region was divided so that it might become are set up, Have the 1st photo detector that receives the diffracted light which condenses by said near side as said photo detector, and the 2nd photo detector that receives the diffracted light which condenses by said backside, and focus error signal detection by spot-size detection system is performed, Tracking error signal detection by the push pull method is performed by dividing said 1st photo detector and said 2nd photo detector into two through an abbreviated optic axis of said diffracted light by a parting line parallel to a track direction of said optical information recording medium.

[Claim 2]In the optical pickup device according to claim 1, said 1st photo detector and said 2nd photo detector A light-receiving field where width is narrow respectively, An optical pickup device being divided into at least three light-receiving fields with a wide light-receiving field of both sides of this light-receiving field, detecting the amount of gaps of said catoptric light in a light-receiving field of an outermost part of these light-receiving fields, and amending a direct-current-offset ingredient of said tracking error signal.

[Claim 3]An optical pickup device, wherein said outermost light-receiving field has not hung on a field with which a zero order light and the primary [**] diffracted light lap among diffraction patterns by a groove slot of said optical information recording medium of said catoptric light in the optical pickup device according to claim 2.

[Claim 4]A light source.

Element condensing for condensing emitted light from this light source on an optical information recording medium, a photo detector which receives catoptric light from said optical information recording medium, and is changed into an electrical signal, and a diffraction element which diffracts catoptric light from said optical information recording medium, and is led to said photo detector.

Are the optical pickup device provided with the above, and said diffraction element has the diffraction region divided into two or more fields in a field with which a moving range of said catoptric light accompanying movement of said element condensing is compensated at least, While the primary [+] diffracted light produced in some two or more fields of said two or more fields condenses by a near side of said photo detector, said diffraction element and said photo detector, It is arranged so that the primary [+] diffracted light produced in some two or more fields of others of said two or more fields may condense by the backside of said photo detector, And two or more fields where it is not based on a position of said catoptric light in a diffraction region of said diffraction element, but light volume of the condensing diffracted light from said some of two or more fields to said photo detector and light volume of the condensing diffracted light from some two or more fields besides the above to said photo detector spread abbreviation etc. and where said diffraction region was divided so that it might become are set up, Have the 1st photo detector that receives the diffracted light which condenses by said near side as said photo detector, and the 2nd photo detector that receives the diffracted light which condenses by said backside, and focus error signal detection by spot-size detection system is performed, Two light-receiving fields which receive a part of field with which a zero order light and the primary [**] diffracted light lap among diffraction patterns by a groove slot of said optical information recording medium of said catoptric light are established in said 1st photo detector and said each of 2nd photo detector, A signal acquired in these light-receiving fields is calculated, and a tracking error signal is detected.

[Claim 5]A light source.

Element condensing for condensing emitted light from this light source on an optical information recording medium, a photo detector which receives catoptric light from said optical information recording medium, and is changed into an electrical signal, and a diffraction element which diffracts catoptric light from said optical information recording medium, and is led to said photo detector.

Are the optical pickup device provided with the above, and said diffraction element has the diffraction region divided into two or more fields in a field with which a moving range of said catoptric light accompanying movement of said element condensing is compensated at least, While the primary [+] diffracted light produced in some two or more fields of said two or more fields condenses by a near side of said photo detector, said diffraction element and said photo detector, It is arranged so that the primary [+] diffracted light produced in some two or more fields of others of said two or more fields may condense by the backside of said photo detector, And two or more fields where it is not based on a position of said catoptric light in a diffraction region of said diffraction element, but light volume of the condensing diffracted light from said some of two or more fields to said photo detector and light volume of the condensing diffracted light from some two or more fields besides the above to said photo detector spread abbreviation etc. and where said diffraction region was divided so that it might become are set up, Have the 1st photo detector that receives the diffracted light which condenses by said near side as said photo detector, and the 2nd photo detector that receives the diffracted light which condenses by said backside, calculate an electrical signal acquired with these the 1st photo detector and 2nd photo detector, and a focus error signal is detected, Two diffraction regions which diffract a part of field with which a zero order light and the primary [**] diffracted light lap among diffraction patterns by a groove slot of said optical information recording medium of said catoptric light are established in said diffraction element, At least two another photo detectors which receive the two diffracted lights by this 2 ** diffraction region, respectively are arranged, a signal acquired with these photo detectors is calculated, and a tracking error signal is detected.

[Claim 6]An optical pickup device, wherein said diffraction element is arranged at said light source close-attendants side of said element condensing and moves in one with said element condensing in an optical pickup device of any one statement of claim 1-5.

[Claim 7]An optical pickup device having used said diffraction element as a polarizability diffraction element which differs in a diffraction operation by a polarization direction in an optical pickup device of any one statement of claim 1-6, and having arranged 1/4 wavelength plate between this polarizability diffraction element and said element condensing.

[Claim 8]An optical pickup device, wherein said diffraction element is blaze-ized in an optical pickup device of any one statement of claim 1-7 so that diffraction efficiency of the primary [+] diffracted light may become the highest.

[Claim 9]An optical pickup device, wherein a signal generating circuit which generates said each error signal and an adjustment signal comprises an arithmetic circuit which said photo detector contains in an optical pickup device of any one statement of claim 1-8.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention separates the incident light from a light source, and the catoptric light from an optical information recording medium using a diffraction element, and relates to the optical pickup device which performs record and/or reproduction of information.

[0002]

[Description of the Prior Art]The optical pickup device which performs record of information and playback to optical information recording media, such as CD and DVD, has the dramatically strong request of slimming down and low-cost-izing. Development of the optical pickup device using the diffraction element as one of what [the] meets such a request is prosperous. As an optical pickup device using the hologram element as a diffraction element, there is a thing of composition of having been indicated to JP,04-311828,A. This optical pickup device, It comprises the semiconductor laser 1, the collimate lens 2 and the hologram elements 3 and 4 as a diffraction element which are light sources as shown in drawing 25, the 1/4 wavelength plate 5, the object lens 6, the optical disc 7 as an optical information recording medium, and the photo-diodes 8 and 9 that are photo detectors.

[0003]P polarization emitted from the semiconductor laser 1 is made into almost parallel light with the collimate lens 2, and is condensed on the optical disc 7 with the object lens 6 via the holograms 3 and 4 and the 1/4 wavelength plate 5. Although the catoptric light from the optical disc 7 passes along the object lens 6 and the 1/4 wavelength plate 5, it turns into S polarization by penetrating the 1/4 wavelength plate 5 twice. The hologram element 4 functions also as element condensing which functions as a light-path-separation element into which the light flux from the semiconductor laser 1 and the catoptric light from the optical disc 7 are made to divide, and makes the photo-diodes 8 and 9 condense the catoptric light from the optical disc 7. Therefore, the hologram element 4 diffracts at an angle of predetermined to an incident light axis, and S polarization from the 1/4 wavelength plate 5 is condensed and received by the photo-diodes 8 and 9.

[0004]The thing as shown in drawing 26 is known as an example of an optical pickup device which performs focus error signal detection by spot-size detection system, and tracking error signal detection by the push pull method. The light flux from the light source 10 is condensed with the object lens 12 as element condensing via the diffraction element 11 by the optical disc 13 as an optical information recording medium, and this optical disc 13 is rotated by the actuator which is not illustrated.

[0005]The diffraction pattern 11a of the diffraction element 11 divided into two in the abbreviated optical axis position as the catoptric light from the optical disc 13 was shown in drawing 27. By 11b, it was divided two, and diffracted, and while was diffracted by the diffraction pattern 11a, and while the diffracted light 14 is condensed by the near side of the photo detector 15, the diffracted light 17 of another side diffracted by the diffraction pattern 11b is condensed by the back side of the photo detector 16. A thing as shows drawing 28 the split pattern of the light-receiving field in the photo detectors 15 and 16 is mentioned. The numerals 18 in drawing 27 show the catoptric light from the optical disc 13. The light-receiving fields 15a-15c where the photo detectors 15 and 16 were trichotomized, respectively as for the diffracted lights 14 and 17 divided into two, Light is received by 16a-16c, it calculates with the following computing equations in the arithmetic circuit which the signals 15A-15C and 16A-16C acquired from these light-receiving fields 15a-15c and 16a-16c, respectively do not illustrate, and the focus error signal FES is acquired.

[0006]
$$FES = (15A + 15C + 16B) - (15B + 16A + 16C)$$

It calculates with the following computing equations in the arithmetic circuit which the signals 15A-15C and 16A-16C acquired from the light-receiving fields 15a-15c and 16a-16c, respectively do not illustrate, and the tracking error signal TES is acquired.

$$TES = (15A + 15B + 15C) - (16A + 16B + 16C)$$

In the optical pickup which equipped JP,9-63076,A with the diffraction element which leads the optical beam reflected with the information recording medium to a photo detector according to the diffraction effect, The optical pickup having leaned and arranged said diffraction element to the optic axis of an optical beam is indicated so that a position gap bordering on the area division line of said photo detector can detect a focus and a non-focusing state.

[0007]An optical disc is irradiated with the light flux emitted to JP,10-49884,A from the light source via a condensing means, Diffract the reflected light flux from this optical disc by a transmission type diffraction element to the photodetection means side, and the this diffracted reflected light flux in the optical pickup device to detect by said photodetection means said diffraction element, It has four fields divided by the prolonged parting line roughly

along the radial direction of said optical disc so that it might intersect perpendicularly with the prolonged parting line and this parting line roughly along the track direction of said optical disc, Two fields of one diagonal line position of these 4 ** fields, and two fields of the diagonal line position of another side, The space change corresponding to this focus condition is given to this each reflected light flux, respectively so that comparison of the reflected light flux diffracted in this one two fields and the reflected light flux diffracted in two fields of this another side can detect a focus condition, Said condensing means is set up move approximately along with the radial direction of said optical disc for tracking.

Said photodetection means is provided with at least two acceptance surfaces which it comes to divide by the parting line which approximately met in the direction to which the condensing spot of said diffracted reflected light flux for focal state detection moves by the wavelength variation of said light source, Have 2 sets of photodetection parts for the focal state detection in which this each acceptance surface has length longer than said migration length, and said one photodetection part detects the reflected light flux diffracted in two fields of said one diagonal line position, and. The optical pickup device, wherein the photodetection part of said another side detects the reflected light flux diffracted in two fields of the diagonal line position of said another side is indicated.

[0008]The optic for condensing the emitted light from a light source and this light source on a record carrier at JP,11-25480,A, The photo detector which receives the catoptric light from the above-mentioned record carrier, and is changed into an electrical signal, In the optical pickup device which has the 1st diffraction grating that divides the emitted light from the above-mentioned light source into plurality, and is entered in the above-mentioned record carrier, and the 2nd diffraction grating that diffracts the catoptric light from the above-mentioned record carrier, and is led to the above-mentioned photo detector, The field for focus error detection which the above-mentioned photo detector receives the zero-order diffracted light from the 1st diffraction grating of the above, and outputs the signal according to a focus error, Receive the secondary more than diffracted light from the 1st diffraction grating of the above, and it has a field for wavelength variation detection which outputs the signal according to the wavelength variation of the diffracted light from the 2nd diffraction grating of the above, The focal error signal generating circuit which generates a focus error signal from the signal which the field for focus error detection of the above-mentioned photo detector outputs, The optical pickup device provided with the correction signal generating circuit which generates the adjustment signal which amends change of the above-mentioned focus error signal resulting from the wavelength variation of the diffracted light from the 2nd diffraction grating of the above from ** which the field for wavelength variation detection of the above-mentioned photo detector outputs is indicated.

[0009]

[Problem(s) to be Solved by the Invention]In the optical pickup device using the diffraction element 11 divided into two as mentioned above. . By the tracking operation for moving the condensing spot by the object lens 12 to the track position of the request on the optical disc 13, as shown in drawing 29, move the object lens 12 in the direction (radial direction) which intersects perpendicularly with a track direction. In this case, as the position of the catoptric light in the diffraction element 11 shows drawing 31, it becomes very imbalanced to the diffraction patterns 11a and 11b, and the imbalance of the light volume of the catoptric light in the diffraction patterns 11a and 11b arises.

[0010]Therefore, the diffracted lights 14 and 17 from the diffraction patterns 11a and 11b also come to be shown in drawing 32 on the light-receiving fields 15a-15c and 16a where the photo detector 15 was trichotomized - 16c, and the imbalance of the intensity of the diffracted lights 14 and 17 produces them. For this reason, FES does not become zero, but big influence produces it in S character curve characteristic (relation between a defocusing amount and FES), and the direct-current-offset ingredient according to the movement magnitude of the object lens 12 produces TES. Drawing 34 and drawing 35 show an example of degradation of the FES characteristic by movement of the object lens 12 in the optical pickup device shown in drawing 26, and the TES characteristic. The imbalance of the above light volume is generated as it is similarly shown in drawing 33, when the optical disc 13 carries out a tilt, as shown in drawing 30.

[0011]This invention is not based on movement of element condensing or the tilt of an optical information recording medium accompanying tracking. A focus error signal and a tracking error signal without offset or degradation can be acquired, and it aims at providing the optical pickup device which can perform the good and stabilized focus servo and a track servo.

[0012]

[Means for Solving the Problem]In order to attain the above-mentioned purpose, an invention concerning claim 1, A light source and element condensing for condensing emitted light from this light source on an optical information recording medium, In an optical pickup device which has a photo detector which receives catoptric light from said optical information recording medium, and is changed into an electrical signal, and a diffraction element which diffracts catoptric light from said optical information recording medium, and is led to said photo detector, Said diffraction element has the diffraction region divided into two or more fields in a field with which a moving range of said catoptric light accompanying movement of said element condensing is compensated at least, While the primary [+] diffracted light produced in some two or more fields of said two or more fields condenses by a near side of said photo detector, said diffraction element and said photo detector, It is arranged so that the primary [+] diffracted light produced in some two or more fields of others of said two or more fields may condense by the backside of said photo detector, And two or more fields where it is not based on a position of said catoptric light in a diffraction region of said diffraction element, but light volume of the condensing diffracted light from said some of two or more fields to said photo detector and light volume of the condensing diffracted light from some two or more fields

besides the above to said photo detector spread abbreviation etc. and where said diffraction region was divided so that it might become are set up, The 1st photo detector that receives the diffracted light which condenses by said near side as said photo detector, Have the 2nd photo detector that receives the diffracted light which condenses by said backside, and focus error signal detection by spot-size detection system is performed, Tracking error signal detection by the push pull method is performed by dividing said 1st photo detector and said 2nd photo detector into two through an abbreviated optic axis of said diffracted light by a parting line parallel to a track direction of said optical information recording medium.

[0013]In the optical pickup device according to claim 1 an invention concerning claim 2, Said 1st photo detector and said 2nd photo detector A light-receiving field where width is narrow respectively, It is divided into at least three light-receiving fields with a wide light-receiving field of both sides of this light-receiving field, the amount of gaps of said catoptric light is detected in a light-receiving field of an outermost part of these light-receiving fields, and a direct-current-offset ingredient of said tracking error signal is amended.

[0014]An invention concerning claim 3 has not required said outermost light-receiving field for a field with which a zero order light and the primary [**] diffracted light lap among diffraction patterns by a groove slot of said optical information recording medium of said catoptric light in the optical pickup device according to claim 2.

[0015]Element condensing for an invention concerning claim 4 to condense emitted light from a light source and this light source on an optical information recording medium, In an optical pickup device which has a photo detector which receives catoptric light from said optical information recording medium, and is changed into an electrical signal, and a diffraction element which diffracts catoptric light from said optical information recording medium, and is led to said photo detector, Said diffraction element has the diffraction region divided into two or more fields in a field with which a moving range of said catoptric light accompanying movement of said element condensing is compensated at least, While the primary [+] diffracted light produced in some two or more fields of said two or more fields condenses by a near side of said photo detector, said diffraction element and said photo detector, It is arranged so that the primary [+] diffracted light produced in some two or more fields of others of said two or more fields may condense by the backside of said photo detector, And two or more fields where it is not based on a position of said catoptric light in a diffraction region of said diffraction element, but light volume of the condensing diffracted light from said some of two or more fields to said photo detector and light volume of the condensing diffracted light from some two or more fields besides the above to said photo detector spread abbreviation etc. and where said diffraction region was divided so that it might become are set up, The 1st photo detector that receives the diffracted light which condenses by said near side as said photo detector, Have the 2nd photo detector that receives the diffracted light which condenses by said backside, and focus error signal detection by spot-size detection system is performed, Two light-receiving fields which receive a part of field with which a zero order light and the primary [**] diffracted light lap among diffraction patterns by a groove slot of said optical information recording medium of said catoptric light are established in said 1st photo detector and said each of 2nd photo detector, A signal acquired in these light-receiving fields is calculated, and a tracking error signal is detected.

[0016]Element condensing for an invention concerning claim 5 to condense emitted light from a light source and this light source on an optical information recording medium, In an optical pickup device which has a photo detector which receives catoptric light from said optical information recording medium, and is changed into an electrical signal, and a diffraction element which diffracts catoptric light from said optical information recording medium, and is led to said photo detector, Said diffraction element has the diffraction region divided into two or more fields in a field with which a moving range of said catoptric light accompanying movement of said element condensing is compensated at least, While the primary [+] diffracted light produced in some two or more fields of said two or more fields condenses by a near side of said photo detector, said diffraction element and said photo detector, It is arranged so that the primary [+] diffracted light produced in some two or more fields of others of said two or more fields may condense by the backside of said photo detector, And two or more fields where it is not based on a position of said catoptric light in a diffraction region of said diffraction element, but light volume of the condensing diffracted light from said some of two or more fields to said photo detector and light volume of the condensing diffracted light from some two or more fields besides the above to said photo detector spread abbreviation etc. and where said diffraction region was divided so that it might become are set up, It has the 1st photo detector that receives the diffracted light which condenses by said near side as said photo detector, and the 2nd photo detector that receives the diffracted light which condenses by said backside, Calculate an electrical signal acquired with these the 1st photo detector and 2nd photo detector, and a focus error signal is detected, Two diffraction regions which diffract a part of field with which a zero order light and the primary [**] diffracted light lap among diffraction patterns by a groove slot of said optical information recording medium of said catoptric light are established in said diffraction element, At least two another photo detectors which receive the two diffracted lights by this 2 ** diffraction region, respectively are arranged, a signal acquired with these photo detectors is calculated, and a tracking error signal is detected.

[0017]In an optical pickup device of any one statement of claim 1-5, said diffraction element is arranged at said light source close-attendants side of said element condensing, and an invention concerning claim 6 moves in one with said element condensing.

[0018]In an optical pickup device of any one statement of claim 1-6, an invention concerning claim 7 uses said diffraction element as a polarizability diffraction element which differs in a diffraction operation by a polarization direction, and arranges 1/4 wavelength plate between this polarizability diffraction element and said element condensing.

[0019]In an optical pickup device of any one statement of claim 1-7, an invention concerning claim 8 is blaze-ized so that, as for said diffraction element, diffraction efficiency of the primary [+] diffracted light may become the highest.

[0020]A signal generating circuit where an invention concerning claim 9 generates said each error signal and an adjustment signal in an optical pickup device of any one statement of claim 1-8 comprises an arithmetic circuit which said photo detector contains.

[0021]

[Embodiment of the Invention]Drawing 1 shows a 1st embodiment of this invention. The optical pickup device of this 1st embodiment separates the incident light from a light source, and the catoptric light from an optical information recording medium using a diffraction element. In the optical pickup device shown in drawing 26 which is one gestalt of the optical pickup device which performs record and reproduction (or only record of information or only reproduction of information) of information, and was mentioned above, The diffraction element 19 by which hyperfractionation was carried out instead of the diffraction element 11 divided into two is used, and the photo detectors 20 and 21 are used instead of being the photo detectors 15 and 16. In drawing 1, identical codes are given to drawing 26 and identical parts.

[0022]The diffraction region of the diffraction element 19 is a diffraction region with which the moving range of the catoptric light from the optical disc 13 accompanying movement of the object lens 12 as element condensing is compensated at least, and is divided into many fields. As shown, for example in drawing 2 (a), the diffraction regions 19a and 19b where two diffraction operations differ used the thing of the gestalt located in a line by turns in the shape of a rectangle, but this hyperfractionation diffraction element 19. The diffraction regions 19a and 19b where two diffraction operations differ as shown in drawing 2 (b) may use the thing etc. of the gestalt located in a line with matrix form.

[0023]While the primary [+] diffracted light 22 produced in the diffraction region 19a condenses by the near side of the photo detector 20, the diffraction element 19 and the photo detectors 20 and 21, It is arranged so that the primary [+] diffracted light 23 produced in the diffraction region 19b may condense by the backside of the photo detector 21. It is not based on the position of the catoptric light in the diffraction regions 19a and 19b of the diffraction element 19, but And the light volume of the condensing diffracted light 22 from the diffraction region 19a to the photo detector 20, Two or more fields where the light volume of the condensing diffracted light 23 to the photo detector 21 from the diffraction region 19b spreads abbreviation etc. and where the diffraction regions 19a and 19b were divided so that it might become are set up.

[0024]The diffraction region 19a diffracts, it condenses before the photo detector 20, the diffraction region 19b diffracts, and the catoptric light which entered into the hyperfractionation diffraction element 19 via the object lens 12 from the optical disc 13 condenses by the backside of the photo detector 21. Drawing 3 shows the light-receiving spots 22S and 23S of the diffracted light on the photo detector 20 and 21. The diffracted-light spot 22S on the photo detector 20 in which the light-receiving field in the photo detectors 20 and 21 receives the diffracted light 22 from the diffraction region 19a, There are the light-receiving fields 20a-20f and 21a-21f which trichotomized into the track direction the diffracted-light spot 23S on the photo detector 21 which receives the diffracted light 23 from the diffraction region 19b, respectively, and were divided into two by the parting line parallel to a track direction through the abbreviated optic axis of the diffracted lights 22 and 23, respectively.

[0025]Drawing 9 and drawing 10 show each example of the focus error signal generating circuit used for this embodiment. Each light-receiving fields 20a-20f which this focus error signal generating circuit consisted of the arithmetic circuit 24, and the photo detectors 20 and 21 trichotomized, They are the signals 20A-20F and 21A-21F acquired from 21a-21f, respectively The following computing equation $FES = (20A+20C+20D+20F+21B+21E) - (20B+20E+21A+21C+21D+21F)$

Or $FES = (20B+20E) - (21B+21E)$

By it being alike and calculating more, focus error signal detection by spot-size detection system is performed, and the focus error signal FES is generated. A focus servo system including this focus error signal generating circuit moves the object lens 12 to an optical axis direction according to the focus error signal FES, and performs focusing.

[0026]Drawing 11 shows the tracking-error-signal-generation circuit of this embodiment. Each light-receiving fields 20a-20f which this tracking-error-signal-generation circuit consisted of the arithmetic circuit 25, and the photo detectors 20 and 21 divided into two, They are the signals 20A-20F and 21A-21F acquired from 21a-21f, respectively The following computing equation $TES = (20a+20b+20c+20d+20e+20f) - (21a+21b+21c+21d+21e+21f)$ By it being alike and calculating more, tracking error signal detection by the push pull method is performed, and the tracking error signal TES is generated.

[0027]As shown in drawing 29 here, when the object lens 12 moves in the direction which intersects perpendicularly with a track direction by tracking operation, as the catoptric light 18 on the hyperfractionation diffraction element 19 is also shown in drawing 4, move to a real line position from a dotted-line position in an arrow direction, but. Since hyperfractionation of the diffraction element 19 is carried out, the light volume of the catoptric light 18 enters by the approximately said ratio in the diffraction region 19a and the diffraction region 19b. Therefore, there is nothing that become out of balance as [a thing] the diffracted-light spots 22S and 23S on the photo detector 20 and 21 shown in drawing 32, and the state of the diffracted-light spots 22S and 23S as shown in drawing 3 is maintained mostly. For this reason, even if the object lens 12 moves by tracking operation, neither degradation nor offset arises in the focus error signal FES.

[0028]Drawing 5 shows the focal error property at the time of moving the object lens 12 with the optical pickup device of this embodiment. In the characteristic of drawing 5, the movement magnitude of the object lens 12 is the same as the characteristic of drawing 34. In the characteristic of drawing 5, it is obtained in stable S character curve characteristic which does not almost have change in S character curve characteristic (relation between a defocusing amount and FES) as compared with the characteristic of drawing 34 even when the object lens 12 moves (it shifted), and has neither degradation nor offset.

[0029]Although the hyperfractionation diffraction element 19 used the thing of the gestalt with which the diffraction regions 19a and 19b where two diffraction operations differ were located in a line by turns in the shape of a rectangle, This invention is not limited to this and the hyperfractionation diffraction element 19, What the diffraction regions 19a and 19b where two diffraction operations differ as shown in drawing 2 (b) were subdivided in the shape of a lattice, and was located in a line with matrix form may be used, Even when the catoptric light which enters into the diffraction element 19 moves by movement of the object lens 12, what is necessary is just the division shape to which covers the movement region, and it always enters into the two diffraction regions 19a and 19b uniformly, and the light volume of the two diffracted lights 22 and 23 becomes uniform.

[0030]The light-receiving area division pattern of the photo detectors 20 and 21 just detects the light intensity change by the difference in the spot size of each diffracted lights 22 and 23. You may make it the photo detectors 20 and 21 receive the diffracted lights 22 and 23 with one photo detector, without receiving each diffracted lights 22 and 23 separately. Although the finite optical system is used in the optical pickup device shown in drawing 1, this invention is applicable also as an infinite optical system which has arranged the collimate lens 26 for making light flux from the light source 10 into a parallel beam between the object lens 12 as element condensing, and the diffraction element 19 as shown in drawing 8.

[0031]By drawing 1, are illustrating the diffracted-light spots 22S and 23S on the light source 10 and the photo detector 20 and 21 as allocated in the same side, but. The catoptric light from the optical disc 13 is just the arrangement which condenses before a photo detector by the diffraction region 19a, and condenses by the back side of a photo detector by the diffraction region 19b, and does not necessarily need to be in the same field.

[0032]By thus, the thing which tracking error signal detection is possible by dividing the photo detectors 20 and 21 into two by a parting line parallel to a track direction, and you subdivide the diffraction region of the diffraction element 19, and is made to diffract catoptric light. Even when the object lens 12 moves in the direction which intersects perpendicularly with a track direction by tracking operation, neither degradation nor offset arises in a focus error signal, but the always stable focus error signal detection is attained.

[0033]As mentioned above, according to a 1st embodiment, the diffraction element 19 has the diffraction region divided into two or more fields in the field with which the moving range of the catoptric light accompanying movement of the object lens 12 as element condensing is compensated at least (it contains), While the primary [+] diffracted light produced in some two or more fields 19a of two or more above-mentioned fields condenses by the near side of the photo detector 20, the diffraction element 19 and the photo detectors 20 and 21, It is arranged so that the primary [+] diffracted light produced in some two or more fields 19b of the others of two or more above-mentioned fields may condense by the backside of the photo detector 21, To and the diffraction region of the diffraction element 19. Two or more fields where it is not based on the position of the above-mentioned catoptric light which can be set, but the light volume of the condensing diffracted light from two or more fields 19a of a part of above to the photo detector 20 and the light volume of the condensing diffracted light from some two or more fields 19b besides the above to the photo detector 21 spread abbreviation etc. and where the diffraction region was divided so that it might become are set up, Have the 1st photo detector 20 that receives the diffracted light which condenses by the above-mentioned near side as a photo detector, and the 2nd photo detector 21 that receives the diffracted light which condenses by the backside [the above], and focus error signal detection by spot-size detection system is performed, Since tracking error signal detection by the push pull method is performed by dividing the 1st photo detector 20 and 2nd photo detector 21 into two through the abbreviated optic axis of the above-mentioned diffracted light by a parting line parallel to the track direction of the optical disc 13 as an optical information recording medium, It cannot be based on movement of an object lens or the tilt of an optical information recording medium accompanying tracking, but a focus error signal without offset or degradation can be acquired, and the good and stabilized focus servo can be performed.

[0034]As a 1st embodiment of the above is shown in drawing 6, it is the diffracted-light spot 22S (as actually shown in drawing 3, it becomes what was divided by the hyperfractionation diffraction element 19, but.) on the photo detector 20. expressing circularly for convenience — **** — the light-receiving field 20a of the outermost part of the inside of the light-receiving fields 20a-20f trichotomized into the track direction on the photo detector 20 when it moved. Since 20d, 20c, and 20f have little influence of the diffraction pattern by the groove slot of the catoptric light spot 22S, The signal according to the movement magnitude of the catoptric light spot 22S can be acquired by taking the difference of the signal acquired from the light-receiving field arranged in the radial direction among these outermost light-receiving fields 20a, 20d, 20c, and 20f.

[0035]Although this is the same also about the photo detector 21, As shown in drawing 7, the move direction of the catoptric light spots 22S and 23S by movement of the object lens 12 like an arrow on the photo detector 20 and 21 Since it is mutually reverse, The spot gap signal showing movement of the object lens 12 or the amount of gaps of the catoptric light spots 22S and 23S by the tilt of the optical disc 13 is as follows.

Spot gap signal = (20a+20c) - (20d+20f) + (21d+21f) - (21a+21c)

Here, drawing 12 shows the relation between the amount of gaps of the catoptric light spots 22S and 23S (the

amount of spot gaps), and track offset (offset of a tracking error signal), and drawing 13 shows the relation between the amount of spot gaps, and a spot gap signal. Since these relations have an almost-like proportionally relation for both, the relation between track offset and a spot gap signal also turns into proportionality. Therefore, a track offset adjustment signal can be acquired by multiplying a spot gap signal by the constant k.

[0036] Then, a tracking-error-signal-generation circuit as shown in drawing 14 in a 1st embodiment of the above by a 2nd embodiment of this invention instead of the tracking-error-signal-generation circuit shown in drawing 11 is used. The photo detectors 20 and 21 The light-receiving fields 20b, 20e, 21b, and 21e where width is narrow respectively, It is divided into at least three light-receiving fields with the wide light-receiving fields 20a, 20d, 20c, 20f, 21a, 21d, 21c, and 21f of the both sides of these light-receiving fields 20b, 20e, 21b, and 21e. The arithmetic circuit 25 where this tracking-error-signal-generation circuit calculates a tracking error signal as mentioned above, The arithmetic circuit 27 which calculates a spot gap signal, and the coefficient unit 28 which acquires a track offset adjustment signal applying the coefficient k to the spot gap signal from this arithmetic circuit 27, It consists of the arithmetic circuit 29 which subtracts and amends the track offset adjustment signal from the coefficient unit 28 to the tracking error signal from the arithmetic circuit 25, The signals 20A-20F acquired from each light-receiving fields 20a-20f and 21a-21f of the photo detectors 20 and 21, respectively, It is 21A-21F The following computing equation $TES = (20a+20b+20c+21d+21e+21f) - (20d+20e+20f+21a+21b+21c) - k\{(20a+20c) - (20d+20f) + (21d+20f) - (21a+21c)\}$

The tracking error signal TES is generated by it being alike and calculating more.

[0037] Therefore, the track offset by movement of the object lens 12 or the tilt of the optical disc 13 can be amended by adding an easy circuit, without increasing the number of partitions of the photo detectors 20 and 21. The arithmetic circuit 27 which calculates a spot gap signal here, and the coefficient unit 28 which acquires a track offset adjustment signal applying the coefficient k to the spot gap signal from this arithmetic circuit 27, The arithmetic circuit 29 which subtracts and amends the track offset adjustment signal from the coefficient unit 28 to the tracking error signal from the arithmetic circuit 25 constitutes a track offset correction circuit.

[0038] According to a 2nd embodiment, in a 1st embodiment, the photo detectors 20 and 21 Thus, the light-receiving fields 20b, 20e, 21b, and 21e where width is narrow respectively, The wide light-receiving field 20a of the both sides of these light-receiving fields 20b, 20e, 21b, and 21e, It is divided into at least three light-receiving fields with 20d, 20c, 20f, 21a, 21d, 21c, and 21f, Since the amount of gaps of catoptric light is detected in the light-receiving fields 20a, 20d, 20c, 20f, 21a, 21d, 21c, and 21f of the outermost part of these light-receiving fields and the direct-current-offset ingredient of a tracking error signal is amended, The track offset by movement of the object lens 12 or the tilt of the optical disc 13 can be amended by adding an easy circuit, without increasing the number of partitions of the photo detectors 20 and 21.

[0039] According to a 3rd embodiment of this invention, in a 2nd embodiment of the above, as shown in drawing 15, the photo detector 20 is set up so that the parting line 30 of a radial direction may not start the field 31 with which the zero order light of the diffraction patterns by the groove slot of the catoptric light spot 22S and the primary [**] diffracted light lap. For this reason, in the outermost light-receiving fields 20a, 20d, 20c, and 20f of the track direction of the photo detector 20, Since there is no change of the light volume by diffraction also in the case where the condensing spot on the optical disc 13 straddles a groove slot, it becomes possible to be stabilized and to detect the above-mentioned spot gap signal. This is the same also about the photo detector 21. Therefore, it becomes detectable [the tracking error signal which was stabilized, could perform track offset amendment and was stabilized by extension].

[0040] Although the parting line 30 of a radial direction is dividing the light-receiving field of the photo detector 20 into three in drawing 15 in the track direction, When the parting line 30 is kept from starting the diffraction pattern 31, the central light-receiving field 20b, Since the width of 20e becomes large and the detection sensitivity (inclination of the straight-line portion of S character curve characteristic (relation between a defocusing amount and FES)) of a focal error is affected, As shown in drawing 16, the number of partitions of the track direction of the photo detector 20 may be increased, and the parting line 30 suitable for focus error detection and each spot gap signal detection may be set up. This is the same also about the photo detector 21.

[0041] According to a 3rd embodiment, as mentioned above, the outermost light-receiving field 20a in a 2nd embodiment, Since the field 31 with which a zero order light and the primary [**] diffracted light lap among the diffraction patterns by the groove slot of optical DESUSUKU 13 of the catoptric light 22 has not cost 20d, 20c, 20f, 21a, 21d, 21c, and 21f, It becomes detectable [the tracking error signal which was stabilized, could perform track offset amendment and was stabilized by extension].

[0042] In a 4th embodiment of this invention, a focus error signal generating circuit and the below-mentioned tracking-error-signal-generation circuit as shown in drawing 17 are used in a 1st embodiment of the above, The light-receiving fields 20a-20c and 21a-21c which trichotomized the photo detectors 20 and 21 into the track direction, The two light-receiving fields 32p, 32q, 33p, and 33q which receive only the part in the field with which the zero order light of the diffraction patterns by the groove slot of the catoptric light spots 22S and 23S and the primary [**] diffracted light lap are formed.

[0043] Focus error signal generating circuits are the signals 20A-20C and 21A-21C which consist of an arithmetic circuit which is not illustrated and are acquired from the light-receiving fields 20a-20c and 21a-21c, respectively The following computing equation $FES = (20A+20C+21B) - (20B+21A+21C)$

Or by calculating by $FES = 20B - 21B$, focus error signal detection by spot-size detection system is performed, and the focus error signal TES is generated.

[0044]Tracking-error-signal-generation circuits are the signals 32P, 32Q, 33P, and 33Q which consist of the arithmetic circuit 34 and are acquired from the light-receiving fields 32p, 32q, 33p, and 33q, respectively The following computing equation $TES = (20P+21Q) - (20Q+21P)$

By it being alike and calculating more, tracking error signal detection by the push pull method is performed, and the tracking error signal TES is generated.

[0045]The light intensity of the field with which the zero order light of the diffraction patterns by the groove slot of the catoptric light spots 22S and 23S and the primary [**] diffracted light lap is almost constant in the field.

Therefore, since only the part in the field with which the zero order light of the diffraction patterns by the groove slot whose light-receiving fields 32p, 32q, 33p, and 33q of the photo detectors 20 and 21 are the catoptric light spots 22S and 23S, and the primary [**] diffracted light lap is received, By the shift of the object lens 12, or the tilt of the optical disc 13, the catoptric light spot 22S, Even when 23S moves to a radial direction, the light-receiving fields 32p and 32q, Unless it separates from the field with which the zero order light of the diffraction patterns by the groove slot 33p and whose 33q are the catoptric light spots 22S and 23S, and the primary [**] diffracted light lap, the stable tracking error detection without a track-off rat is attained.

[0046]Although elliptical is describing the light-receiving fields 32p, 32q, 33p, and 33q by drawing 17, It is not necessary to be necessarily elliptical and by the shift of the object lens 12, or the tilt of the optical disc 13 The catoptric light spot 22S, What is necessary is to just be set as the field which can always receive the field with which the zero order light of the diffraction patterns by the groove slot of the catoptric light spots 22S and 23S and the primary [**] diffracted light lap, even when 23S moves to a radial direction.

[0047]Thus, the light-receiving field 32p which receives a part of field with which a zero order light and the primary [**] diffracted light lap among the diffraction patterns by the groove slot of the optical disc 13 of catoptric light according to a 4th embodiment, 32q, 33p, and 33q — the photo detectors 20 and 21, since it is alike, respectively, it provides, the signal acquired in these light-receiving fields 32p, 32q, 33p, and 33q is calculated and a tracking error signal is detected, the effect of focus error signal detection of a 1st embodiment of the above — in addition, even when there are a shift of the object lens 12 and a tilt of the optical disc 13, the always stable tracking error signal detection without track offset is attained.

[0048]The two diffraction regions 35p which diffract a part of field where a zero order light and the primary [**] diffracted light lap with the diffraction region of the diffraction element 19 in a 1st embodiment of the above in a 5th embodiment of this invention among the diffraction patterns by the groove slot of the optical disc 13 of the catoptric light 18 as shown in drawing 18, As 35q is provided and it is shown in drawing 19, while the diffracted lights 22 and 23 by the diffraction regions 19a and 19b are received, respectively in the light-receiving fields 20a-20c and 21a-21c trichotomized by the track direction of the photo detectors 20 and 21, The diffracted light by the diffraction regions 35p and 35q is received with the photo detectors 36 and 37, respectively.

[0049]Focus error signal generating circuits are the signals 20A-20C and 21A-21C which consist of an arithmetic circuit which is not illustrated and are acquired from the light-receiving fields 20a-20c and 21a-21c, respectively The following computing equation $FES = (20A+20C+21B) - (20B+21A+21C)$

Or by calculating by $FES = 20B - 21B$, focus error signal detection by spot-size detection system is performed, and the focus error signal TES is generated.

[0050]It is calculating signals [which a tracking-error-signal-generation circuit consists of the arithmetic circuit 39, and are acquired from the photo detectors 36 and 37, respectively / 36s and 37s] difference by the following computing equation $TES = 36 - s - 37s$, Tracking error signal detection by the push pull method is performed, and the tracking error signal TES is generated.

[0051]The light intensity of the field with which the zero order light of the diffraction patterns by the groove slot of the catoptric light 18 and the primary [**] diffracted light lap like a 4th embodiment in this 5th embodiment is almost constant in that field. Therefore, since only the part in the field with which the zero order light of the diffraction patterns by the groove slot of the catoptric light 18 and the primary [**] diffracted light lap in the diffraction regions 35p and 35q is diffracted, Even when the catoptric light 18 moves to a radial direction by the shift of the object lens 12, or the tilt of the optical disc 13, It does not separate from the field with which the zero order light of the diffraction patterns according [the diffraction regions 35p and 35q] to the groove slot of the catoptric light 18 and the primary [**] diffracted light lap, And unless the diffracted-light spots 38p and 38q separate from the light-receiving field of the photo detectors 36 and 37, the stable tracking error signal detection without a track-off rat is attained.

[0052]Although the ellipse is describing the diffraction regions 35p and 35q by drawing 18, What is necessary is not to be necessarily an ellipse, and to just be set as the field which can always diffract the field with which the zero order light of the diffraction patterns by the groove slot of the catoptric light 18 and the primary [**] diffracted light lap, even when the catoptric light 18 moves by the shift of the object lens 12, or the tilt of the optical disc 13.

[0053]The two diffraction regions 35p which diffract a part of field with which a zero order light and the primary [**] diffracted light lap among the diffraction patterns by the groove slot of the optical disc 13 of catoptric light according to this 5th embodiment, Provide 35q in the diffraction element 19, and at least two another photo detectors 36 and 37 which receive the two diffracted lights by the two diffraction regions 35p and 35q, respectively are arranged, Since the signal acquired with these photo detectors 36 and 37 is calculated and a tracking error signal is detected, the effect of focus error signal detection of a 1st embodiment of the above — in addition, even when there are a shift of the object lens 12 and a tilt of the optical disc 13, the always stable tracking error signal detection without track offset is attained.

[0054]According to a 6th embodiment of this invention, in a 5th embodiment of the above, as shown in drawing 20, it is allocated in the light source 10 close-attendants side of the object lens 12 as element condensing, and is fixed to the object lens 12 and one by the attachment component 40, and the diffraction element 19 moves in one with the object lens 12. Even when the object lens 12 moves to a radial direction by tracking operation, in order to move the diffraction element 19 is near the object lens 12, and together, the catoptric light which carried out transmission diffraction of the diffraction element 19 from the optical disc 13 hardly moves.

[0055]According to a 5th embodiment of the above, the diffraction regions 35p and 35q must be made small so that it may not separate from the field with which a zero order light and the primary [**] diffracted light lap, even if the catoptric light 18 from the optical disc 13 moves on the diffraction element 19, as shown in drawing 18. Therefore, the light volume of the diffracted lights 38p and 38q decreases, and there is a possibility that S/N of the signal acquired from the photo detectors 36 and 37 may worsen, and stable tracking error signal detection cannot be performed.

[0056]However, as shown [a 6th embodiment] in drawing 21, in order that the optical disc catoptric light 18 on the diffraction element 19 may hardly move, As shown in drawing 22 and drawing 23, it becomes possible to enlarge area of the diffraction regions 35p and 35q, and the amount of diffraction of the diffracted lights 38p and 38q becomes large by extension, and S/N of the signal acquired from the photo detectors 36 and 37 becomes possible [becoming good and performing stable tracking error signal detection].

[0057]Thus, since according to a 6th embodiment the diffraction element 19 is arranged at the light source 10 close-attendants side of the object lens 12 as element condensing and moves in one with the object lens 12, S/N of the signal acquired from the photo detectors 36 and 37 becomes possible [becoming good and performing stable tracking error signal detection].

[0058]Arrange the diffraction element 19 to the light source 10 close-attendants side of the object lens 12 as element condensing, and it is made to move in one with the object lens 12 in a 2nd embodiment of the above thru/or a 4th embodiment, The two diffraction regions 35p which diffract a part of field with which a zero order light and the primary [**] diffracted light lap among the diffraction patterns by the groove slot of the optical disc 13 of catoptric light, 35q is provided in the diffraction element 19, at least two another photo detectors 36 and 37 which receive the two diffracted lights by the two diffraction regions 35p and 35q, respectively are arranged, the signal acquired with these photo detectors 36 and 37 is calculated, and it may be made to detect a tracking error signal.

[0059]In a 1st embodiment of the above, although the optical path is shown to drawing 1 that a diffraction operation takes place only to the catoptric light from the optical disc 13, the diffraction element 19, Also when the incident light from the light source 10 penetrates the diffraction element 19 actually, diffraction takes place, and the diffracted light which is not shown in drawing 1 occurs in the optical disc 13 side of the diffraction element 19. It is not used for the record reproduction of the information over the optical disc 13, and that part reflects in optical disc 13 grade, and enters into a photo detector as flare light, and this diffracted light becomes a factor which often reduces S/N of a detecting signal.

[0060]In a 1st embodiment of the above thru/or a 6th embodiment at a 7th embodiment of this invention, As shown in drawing 24, the polarizability diffraction element 41 from which a diffraction operation differs by a polarization direction is used instead of the diffraction element 19, respectively, and the 1/4 wavelength plate 42 is further allocated between the polarizability diffraction element 41 and the object lens 12. The light flux of P polarization from the light source 10 is condensed by the optical disc 13 with the object lens 12 via the polarizability diffraction element 41. Although the catoptric light from the optical disc 13 passes along the object lens 12 and the 1/4 wavelength plate 42, it turns into S polarization by penetrating the 1/4 wavelength plate 42 twice, and enters into the polarization time diffraction element 41.

[0061]The polarizability diffraction element 41 does not perform a diffraction operation to P polarization which enters from the light source 10, A diffraction operation is performed to the catoptric light from the optical disc 13 which penetrated the 1/4 wavelength plate 42 twice, and became S polarization, and it becomes possible to improve greatly the separation performance (extinction ratio) of the incident light from the light source 10, and the catoptric light from the optical disc 13. Therefore, in order that the polarizability diffraction element 41 may separate the incident light from the light source 10, and the catoptric light from the optical disc 13, efficiency for light utilization is high, as a result the incident light quantity of a photo detector increases and S/N of a detecting signal improves. Since there is little flare light, S/N improves also in this point.

[0062]Since power of the light source 10 is made to fewer things when S/N of the detecting signal was made comparable, or when making comparable luminous intensity which reaches the recording surface of the optical disc 13, it is possible to suppress the heat of the light source 10 by which it is generated simultaneously with luminescence, and it also becomes energy saving. Since a light source with the smaller maximum emission power with a low price can be used, an optical pickup device is realizable by low cost. It becomes possible for the light source 10 to be able to lessen calorific value, since there is less emission power and it ends, and to prolong the life of the light source 10, and a dramatically reliable optical pickup device can be realized.

[0063]Thus, since according to a 7th embodiment the diffraction element was used as the polarizability diffraction element 41 which differs in a diffraction operation by a polarization direction and the 1/4 wavelength plate 42 has been arranged between the object lenses 12 as this polarizability diffraction element 41 and element condensing, Efficiency for light utilization is high, the incident light quantity of a photo detector increases, flare light decreases, and S/N of a detecting signal improves. When S/N of the detecting signal was made comparable, or when making comparable luminous intensity which reaches the recording surface of the optical disc 13, power of the light source

10 is made to fewer things.

[0064]According to an 8th embodiment of this invention, in a 1st embodiment of the above thru/or a 7th embodiment, it has composition which raises the diffraction efficiency of the primary [+] diffracted light by blaze-izing the diffraction elements 19 and 41, respectively so that the diffraction efficiency of the primary [+] diffracted light may become the highest. When the diffraction elements 19 and 41 are not blaze-ized, Since the diffraction efficiency of a plus degree and a minus degree is the same, temporarily the total diffraction efficiency of the primary [**] diffracted light also as 100%, Although 50% of the half cannot be used, the diffraction efficiency of only the primary [+] diffracted light can be substantially raised by blaze-izing the diffraction elements 19 and 41. Therefore, the efficiency for light utilization of optical disc catoptric light is raised only by blaze-izing the diffraction elements 19 and 41, and the good signal detection of S/N and the good optical pickup device of S/N can be realized by low cost simple.

[0065]Thus, since according to an 8th embodiment the diffraction elements 19 and 41 are blaze-ized so that the diffraction efficiency of the primary [+] diffracted light may become the highest, the efficiency for light utilization of optical disc catoptric light is raised, and the good signal detection of S/N and the good optical pickup device of S/N can be realized by low cost simple.

[0066]In a 1st embodiment of the above thru/or an 8th embodiment at a 9th embodiment of this invention, It has composition which includes a signal amplifying circuit including a focus error signal generating circuit, a tracking-error-signal-generation circuit, and a track offset correction circuit in the photo detectors 20 and 21 (or photo detectors 20, 21, 36, and 37) and in which it is made to build, respectively. For this reason, it is hard to be influenced by an extraneous noise, and it becomes possible to realize the optical pickup device which can perform the generation of a signal and information storage reproduction which were stabilized without adding a circuit to the latter part of a photo detector.

[0067]Thus, since the signal generating circuit which generates each error signal and an adjustment signal comprises an arithmetic circuit which the photo detectors 20 and 21 (or photo detectors 20, 21, 36, and 37) contain according to a 9th embodiment, It is hard to be influenced by an extraneous noise, and it becomes possible to realize the optical pickup device which can perform the generation of a signal and information storage reproduction which were stabilized without adding a circuit to the latter part of a photo detector.

[0068]

[Effect of the Invention]According to the invention which relates to claim 1 as mentioned above, it cannot be based on movement of element condensing or the tilt of an optical information recording medium accompanying tracking, but a focus error signal without offset or degradation can be acquired, and the good and stabilized focus servo can be performed. According to the invention concerning claim 2, the track offset by the shift of element condensing or the tilt of an optical information recording medium can be amended by adding an easy circuit, without increasing the number of partitions of a photo detector.

[0069]According to the invention concerning claim 3, it becomes detectable [the tracking error signal which was stabilized, could perform track offset amendment and was stabilized by extension]. According to the invention concerning claim 4, even when there are a shift of element condensing and a tilt of an optical information recording medium, the always stable tracking error signal detection without track offset is attained.

[0070]According to the invention concerning claim 5, even when there are a shift of element condensing and a tilt of an optical information recording medium, the always stable tracking error signal detection without track offset is attained. According to the invention concerning claim 6, S/N of the signal acquired from a photo detector becomes possible [becoming good and performing stable tracking error signal detection].

[0071]According to the invention concerning claim 7, efficiency for light utilization is high, the incident light quantity of a photo detector increases, flare light decreases, and S/N of a detecting signal improves. When S/N of the detecting signal was made comparable, or when making comparable luminous intensity which reaches the recording surface of an optical information recording medium, power of a light source is made to fewer things.

[0072]According to the invention concerning claim 8, the efficiency for light utilization of optical-information-recording-medium catoptric light is raised, and the good signal detection of S/N and the good optical pickup device of S/N can be realized by low cost simple. According to the invention concerning claim 9, it is hard to be influenced by an extraneous noise, and it becomes possible to realize the optical pickup device which can perform the generation of a signal and information storage reproduction which were stabilized without adding a circuit to the latter part of a photo detector.

[Translation done.]

【特許請求の範囲】

【請求項1】 光源と、この光源からの出射光を光情報記録媒体上に集光するための集光素子と、前記光情報記録媒体から反射光を受光して電気信号に変換する受光素子と、前記光情報記録媒体からの反射光を回折して前記受光素子へ導く回折素子とを有する光ビックアップ装置において、前記回折素子は少なくとも前記集光素子の移動に伴う前記反射光の移動範囲を補う領域で複数の領域に分割された回折領域を持ち、前記回折素子及び前記受光素子は前記複数の領域のうちの一部の複数の領域で生じる+1次回折光が前記受光素子の手前側で集光するとともに、前記複数の領域のうちの他の一部の複数の領域で生じる+1次回折光が前記回折素子の後側で集光するように配置され、かつ前記回折素子の回折領域における前記反射光の位置により前記一部の複数の領域から前記受光素子への集光回折光の光量と前記他の一部の複数の領域から前記受光素子への集光回折光の光量とが略等しくなるように前記回折領域の分割された複数の領域が設定され、前記回折素子として前記手前側で集光する回折素子を受光する第1の受光素子と、前記後側で集光する回折素子を受光する第2の受光素子とを備えていてスポットサイズ後法によるフォーカスエラー信号検出を行い、前記回折光の略光軸を通り前記光情報記録媒体のトラック方向に平行な分路線で前記第1の受光素子及び前記第2の受光素子を分割することによってプッシュプル法によるトラッキングエラー信号検出を行うことを特徴とする光ビックアップ装置。

【請求項2】 請求項1記載の光ビックアップ装置において、前記第1の受光素子及び前記第2の受光素子はそれぞれ、幅の狭い受光領域と、この受光領域の両側の幅の広い受光領域との少なくとも3つの受光領域に分割され、これらの受光領域のうちの最外側の受光領域で前記反射光の光量を検出して前記トラッキングエラー信号の直流成分を補正することを特徴とする光ビックアップ装置。

【請求項3】 請求項2記載の光ビックアップ装置において、前記最外側の受光領域が、前記反射光の前記光情報記録媒体のグループ溝による回折パターンの中の0次光と±1次回折光が重なる領域にかかっていることを特徴とする光ビックアップ装置。

【請求項4】 光源と、この光源からの出射光を光情報記録媒体上に集光するための集光素子と、前記光情報記録媒体からの反射光を受光して電気信号に変換する受光素子と、前記光情報記録媒体からの反射光を回折して前記受光素子へ導く回折素子とを有する光ビックアップ装置において、前記回折素子は少なくとも前記集光素子の移動に伴う前記反射光の移動範囲を補う領域で複数の領域に分割された回折領域を持ち、前記回折素子及び前記受光素子は前記複数の領域のうちの一部の複数の領域で生じる+1次回折光が前記受光素子の手前側で集光すると

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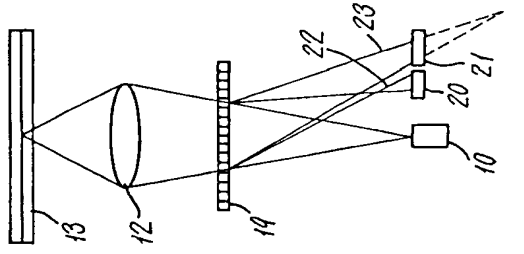
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(54) 【発明の名称】 光ビックアップ装置

(57) 【要約】

【課題】 この発明は、トラッキングに伴う集光素子の移動や光情報記録媒体のチルトによりフォーカスエラー信号及びトラッキングエラー信号のオフセットや劣化が生じるという課題を解決しようとするものである。

【解決手段】 この発明は、回折素子19は少なくとも集光素子12の移動に伴う反射光の移動範囲を補う領域で複数の領域に分割された回折領域を持ち、回折素子19及び受光素子20、21は前記複数の領域のうちの一部の複数の領域で生じる+1次回折光が受光素子20の手前側で集光するとともに、前記複数の領域のうちの他の一部の複数の領域で生じる+1次回折光が受光素子21の後側で集光するように配置され、かつ受光素子20への集光回折光の光量と受光素子21への集光回折光の光量とが略等しくなるように前記回折領域の分割された複数の領域が設定され、スポットサイズ後法によるフォーカスエラー信号検出を行い、前記回折素子の略光軸を通り光情報記録媒体13のトラック方向に平行な分路線を受光素子20、21を2分割することによってプッシュプル法によるトラッキングエラー信号検出を行うものである。



【請求項7】請求項1～6のいずれか1つに記載の光ビ
ックアップ装置において、前記回折素子を偏光方向によ
り回折作用の異なる偏光性回折素子とし、この偏光性回
折素子と前記集光素子との間に1/4波長板を配置した
ことを特徴とする光ビックアップ装置。

【請求項8】請求項1～7のいずれか1つに記載の光ビ
ックアップ装置において、前記回折素子は+1次回折光
の回折効率が最も高くなるようにブレイズ化されている
ことを特徴とする光ビックアップ装置。

【請求項9】請求項1～8のいずれか1つに記載の光ビ
ックアップ装置において、前記各エラー信号及び補正信
号を生成する信号生成回路は前記受光素子が内蔵する演
算回路で構成されていることを特徴とする光ビックアップ
装置。

【発明の詳細な説明】

【0001】
【発明の属する技術分野】本発明は、回折素子を用いて光源からの入射光と情報記録媒体からの反射光を分離し、情報の記録及び／又は再生を行う光ピックアップ装置に関する。

【0002】
 【従来の技術】CD、DVDなどの光情報記録媒体には、薄型化、低コスト化の要否が非常に強い。このような要望に応じるものとして、回折素子を用いた光ビグアップ装置が開発が盛んである。回折素子としてのホログラム素子を用いた光ビグアップ装置として、特開平04-311828号公報に記載された構成のものがあり、図25に示すように光ビグアップ装置である半導体レーザ1、コリメートレンズ2、回折素子としてのホログラム素子3、4、1/4波長板5、対物レンズ6、光情報記録媒体としての光ディスク7、受光素子であるフォトダイオード8、9から構成されている。

【0003】半導体「レーザー1」から放射されるP偏光は、コロレートン22により順平行光とされ、ホログラム素子4及び1/4波長板を介して対物レンズ6に上り、対物レンズ6及び1/4波長板5を通るが、1/4波長板5を2回透過することによってS偏光となる。ホログラム素子4は、半導体「レーザー1」からの光源を光ディスク7からの反射光とを分離させる光路分離素子として機能し、反対の方向、光ディスク7からの反射光をフォトダイオード8、9に集光させる集光素子としても機能する。よって、1/4波長板5からのS偏光は、ホログラム素子4により入射光軸に対して所定の角度で回折される。フォトダイオード8、9に集光されて受光される。

【0004】また、9に集光されて受光される。

【0004】また、9に集光されて受光される。

カスエラー信号検出及びプッシュプル法によるトラッキング
ングエラー信号検出を行う光ピックアップ装置の一例と

して、図26に示すようなものが知られている。光源10からの光束は回折素子11を介して集光素子としての対物レンズ12により光出射部記録体としての光ディスク13に集光され、この光ディスク13は図示しない駆動部により回転駆動される。

【0005】光ディスク13からの反射光は、図27に示すように略光軸位置で2分割された回折素子11の回折パターン11a、11bで2分割されて回折され、回折パターン11aで回折された一方の回折光14が受光

10 素子15の手前側で集光されるとともに、回折パターン

11bで回折された他方の回折光17が受光素子16の
 奥側で集光される。受光素子15、16における受光領
 域の分割パターンは例えば図28に示すようなものが導
 けられる。なお、図27における符号18は光ディスク

13からの反射光を示す。2分割された回折光14、1

7はそれぞれ受光素子15、16の3分割された受光領域15a~15c、16a~16cで受光され、これらの受光領域15a~15c、16a~16cからそれぞれ得られる信号15A~15C、16A~16Cが図示しない演算回路で以下の演算式により演算されてフォー

カスエラ一信号FESが得られる。

$$[0006] \text{ FES} = (15A + 15C + 16B) - (15B + 16A + 16C)$$
 また、受光領域15a~15c、16a~16cからそれぞれ得られる信号15A~15C、16A~16Cが、図示しない演算回路で以下の演算式により演算されてトラックシンクエラ一信号TFSが得られる。

$$\text{TES} = (15A + 15B + 15C) - (16A + 16B + 16C)$$

手段は、トラックインのために前記光ディスクのラジアル方向に略沿って移動するように設定されており、前記光線発生手段は、前記記録の長さ変動によりフォーカス状態が変動する方向に略沿って反折光素子を集光スポットを形成する少なくとも2つの受光面を備え、該各受光面が前記移動する長さよりも長い長さを有するフォーカス能搬出のための光線出口を2組有し、前記一方の光線出口が前記一方の領域で回折されるために反折光素子を後出の対角位置に前記2つの領域で回折されるために反折光素子を出するのときに、前記他方の光線出口が前記出口の対角位置の2つの領域で回折される反折光素子を使用することを特徴とする光ピックアップ装置が記載されている。

【0008】特開平11-25480号公報には、光線と、この光源からの出射光を記録媒体上に集光するため光学部品と、上記記録媒体からの反射光を受光して電光信号に変換する受光素子と、上記光源からの出射光を上記記録媒体に分離して上記記録媒体に入射させる第1回折格子と、上記記録媒体からの反射光を受光し、上記受光素子と導く第2回折格子とを有する光ビックアップ装置において、上記第1回折格子から0次以上の回折光を出射させ、上記第1回折格子からの2次以上の回折光を受光して、上記第2回折格子からの回折光の波長変動に応じた信号を出力する波長変動検出用領域とを備え、上記受光素子のフォース誤差生成用領域が出力する信号がフォース誤差信号を生感する領域が出力する信号から、上記第2回折格子から動検出領域が出力する信号から、上記第2回折格子からの回折の波長変動に対応する補正信号を生成する補正信号を生成する光ビックアップ装置が記載されている。

【0009】
 [発明が解決しようとする課題] 上述のように2分割した回折素子11を用いたビック位置調整では、光ディスク13上の所望のトラック位置に対向素子12に与える集束スポットを移動するためのトラッキング動作により、図9に示すように対物レンズ12をトラック方向に直交する方向（ラジアル方向）に移動させるが、この場合、回折素子11における反射光の位置が図3に示すように回折パターン11a、11bに対して非常にアスペランタになり、回折パターン11a、11bにおける反射光の光量の不均衡が生じる。

【010】よって、回折パターン11a、11bからの回折光14、17も受光素子15の3分された受光領域15a～15c、16a～16c上で図32に示すようになり、回折光14、17の強度の不均が生じる。このため、FESはゼロに近い（大きな影響が生ずる）特性（デフォーカス量とFESとの関係）に大きな影響が生じ、TESは対物レンズ12の移動量に依らず直交オフ

セット成分が生じる。図 3.4 及び図 3.5 は、図 2.6 に示す光ピックアップ装置での対物レンズ 12 の移動による FFS 特性、TES 特性の劣化の一例を示す。また、以上のような光量の不均衡は、図 3.0 に示すように光ディスク 13 がチャットした場合に図 3.3 に示すように発生する。

【0011】本発明は、トラッキングに伴う集光素子のトラッキングに、トラッキング用のチャルトによらず、オフセットや光化のないフォーカスエアー信号及びトラッキングエラー信号を得ることができ、良好で安定したフォーカスサーボ、トラッキングを行うことができる光ビックアップ装置を提供することを目的とする。

【0012】

[illegible]

【0013】請求項2に係る発明は、請求項1記載の光ビックアップ装置において、前記第1の受光素子及び前記第2の受光素子はそれぞれ、幅の狭い受光領域と、この受光領域の両側の幅の広い受光領域と、この2つの受光領域に分割され、これらの受光領域のうちの最も外側の受光領域で仰視方向のズレ値を算出して前記ズレ値の直交成分がゼロとなる位置を算出するものである。

前記反射光の前記光情報記録媒体のグループ溝による回折パターンのうち0次光と±1次回折光が重なる領域にかかっているものである。

【0015】請求項4に係る発明は、光源と、この光源からの出射光を光情報記録媒体上に集光するための集光素子と、前記光情報記録媒体からの反射光を受光して電気信号に変換する受光素子と、前記光情報記録媒体からの反射光を回折して前記受光素子に導く回折素子とを有する光ビックアップ装置において、前記回折素子は少なくとも前記集光素子の移動に伴う前記反射光の移動範囲を捕う領域で複数の領域に分割された回折領域を持ち、前記回折素子及び前記受光素子は前記複数の領域のうち一部の複数の領域で生じる+1次回折光が前記受光素子の手前側で集光するとともに、前記複数の領域のうちの他の一部の複数の領域で生じる+1次回折光が前記受光素子の後側で集光するように配置され、かつ前記回折素子の回折領域における前記反射光の位置によらず前記一部の複数の領域から前記受光素子への集光回折光の光量と前記他の一部の複数の領域から前記受光素子への集光回折光の光量とが略等しくなるように前記回折領域の分割された複数の領域が設定され、前記受光素子として前記手前側で集光する回折光を受光する第1の受光素子と、前記後側で集光する回折光を受光する第2の受光素子とを備えていてスポットサイズ検出法によるフォーカスエラー信号検出を行い、前記回折素子の前記光情報記録媒体のグループ溝による回折パターンのうち0次光と±1次回折光が重なる領域の一部を受光する2つの受光領域を前記第1の受光素子及び前記第2の受光素子それぞれに設け、これらの受光領域で得られる信号を演算してトラッキングエラー信号を算出するものである。

【0016】請求項5に係る発明は、光源と、この光源からの出射光を光情報記録媒体上に集光するための集光素子と、前記光情報記録媒体からの反射光を受光して電気信号に変換する受光素子と、前記光情報記録媒体からの反射光を回折して前記受光素子に導く回折素子とを有する光ビックアップ装置において、前記回折素子は少なくとも前記集光素子の移動に伴う前記反射光の移動範囲を捕う領域で複数の領域に分割された回折領域を持ち、前記回折素子及び前記受光素子は前記複数の領域のうちの一部の複数の領域で生じる+1次回折光が前記受光素子の手前側で集光するとともに、前記複数の領域のうちの他の一部の複数の領域で生じる+1次回折光が前記受光素子の後側で集光するように配置され、かつ前記回折素子の回折領域における前記反射光の位置によらず前記一部の複数の領域から前記受光素子への集光回折光の光量と前記他の一部の複数の領域から前記受光素子への集光回折光の光量とが略等しくなるように前記回折領域の分割された複数の領域が設定され、前記受光素子として前記手前側で集光する回折光を受光する第1の受光素子と、前記後側で集光する回折光を受光する第2の受光素子とを備

え、これらの第1の受光素子及び第2の受光素子で得られる電気信号を演算してフォーカスエラー信号を算出し、前記反射光の前記光情報記録媒体のグループ溝による回折パターンのうち0次光と±1次回折光が重なる領域の一部を回折する2つの回折領域を前記回折素子に設け、該2つの回折領域による2つの回折光をそれぞれ受光する少なくとも2つの別の別の受光素子を配置し、これらの受光素子で得られる信号を演算してトラッキングエラー信号を算出するものである。

【0017】請求項6に係る発明は、請求項1～5のいずれか1つに記載の光ビックアップ装置において、前記回折素子は前記集光素子の前記光源側近傍に配置されて前記集光素子と一体的に移動するものである。

【0018】請求項7に係る発明は、請求項1～6のいずれか1つに記載の光ビックアップ装置において、前記回折素子を偏光方向により回折作用の異なる偏光回折素子とし、この偏光回折素子と前記集光素子との間に1/4波長板を配置したものである。

【0019】請求項8に係る発明は、請求項1～7のいずれか1つに記載の光ビックアップ装置において、前記回折素子は+1次回折光の回折効率が高くなるように偏極化されているものである。

【0020】請求項9に係る発明は、請求項1～8のいずれか1つに記載の光ビックアップ装置において、前記各エラ信号及び補正信号を生成する信号生成回路は前記受光素子が内蔵する演算回路で構成されているものである。

【0021】
【発明の実施の形態】図1は本発明の第1実施形態を示す。この第1実施形態の光ビックアップ装置は、回折素子を用いて光源からの入射光と光情報記録媒体からの反射光を分離し、情報の記録及び再生（もしくは情報の記録のみ、もしくは情報の再生のみ）を行う光ビックアップ装置の一形態であり、前述した図26に示す光ビックアップ装置において、2分割された回折素子11の代りに多分割された回折素子19が用いられ、受光素子15、16の代りに受光素子20、21が用いられる。なお、図1において、図26と同一部分には同一符号が付してある。

【0022】回折素子19の回折領域は、少なくとも集光素子としての対物レンズ12の移動に伴う光ディスク13からの反射光の移動範囲を捕う回折領域であり、複数の領域に分割される。この多分割回折素子19は、例えば図2(a)に示すように2つの回折作用の異なる回折領域19a、19bが短冊形状に交互に並んだ形態のものを用いた。図2(b)に示すように2つの回折作用の異なる回折領域19a、19bがマトリクス状に並んだ形態のものなどを用いてもよい。

【0023】回折素子19及び受光素子20、21は、回折領域19aで生じる+1次回折光22が受光素子2

【0027】ここで、図29に示すように対物レンズ12がトラッキング動作によりトラッキング方向と直交する方向に移動した場合、多分割回折素子19上での反射光18も図4に示すように点線位置から実線位置へ即方向に移動すると、回折素子19が多分割されているため、回折領域19aと回折領域19bとで反射光18の光量が略等しくなるように回折領域19a、19bの分割された複数の領域が設定される。

【0024】光ディスク13から対物レンズ12を介して多分割回折素子19に入射した反射光は、回折領域19aによって回折されて受光素子20の手前で集光し、回折領域19bによって回折されて受光素子21の後側で集光する。図3は、受光素子20、21上での回折光の受光素子22S、23Sを示す。受光素子20、22を受光する受光領域は、回折領域19aからの回折光22を受光する受光素子20上の回折光スポット22Sと、回折領域19bからの回折光23を受光する受光素子21上の回折光スポット23Sとをそれぞれトラッキング方向に3分割し、かつ回折光22、23の略光軸を通りトラッキング方向に平行な分岐線でそれぞれ2分割した受光領域20a～20f、21a～21fがある。

【0025】図9及び図10は本実施形態に用いられるフォーカスエラー信号生成回路の各例を示す。このフォーカスエラー信号生成回路は、演算回路24からなり、受光素子20、21の3分割した各受光領域20a～20f、21a～21fからそれぞれ得られる信号20A～20F、21A～21Fを以下の演算式

$$FES = (20A + 20C + 20D + 20F + 21B + 21E) - (20B + 20E + 21A + 21C + 21D + 21F)$$

もしくは

$$FES = (20B + 20E) - (21B + 21E)$$

により演算することで、スポットサイズ検出法によるフォーカスエラー信号検出を行ってフォーカスエラー信号FESを生成する。このフォーカスエラー信号生成回路を含むフォーカスサーボ系は、フォーカスエラー信号FESに応じて対物レンズ12を光軸方向へ移動させて焦点合わせを行う。

【0026】図11は本実施形態のトラッキングエラー信号生成回路を示す。このトラッキングエラー信号生成回路は、演算回路25からなり、受光素子20、21の2分割した各受光領域20a～20f、21a～21fからそれぞれ得られる信号20A～20F、21A～21Fを以下の演算式

$$TES = (20a + 20b + 20c + 20d + 20e + 20f) - (21a + 21b + 21c + 21d + 21e + 21f)$$

により演算することで、プッシュプル法によるトラッキングエラー信号検出を行ってトラッキングエラー信号TESを生成する。

【0027】図11は本実施形態の光ビックアップ装置で、対物レンズ12を移動させた場合のフォーカスエラー信号を示す。図5の特性では、対物レンズ12の移動量が図34の特性と同一である。図5の特性では、図34の特性と比較して、対物レンズ12が移動した（シフトした）場合でもS字カーブ特性（デフォーカス量とFESとの関係）にほとんど変化がなく、劣化やオフセットのない安定したS字カーブ特性が得られる。

【0028】図5は本実施形態の光ビックアップ装置で、対物レンズ12を移動させた場合のフォーカスエラー信号を示す。図5の特性では、対物レンズ12の移動量が図34の特性と同一である。図5の特性では、図34の特性と比較して、対物レンズ12が移動した（シフトした）場合でもS字カーブ特性（デフォーカス量とFESとの関係）にほとんど変化がなく、劣化やオフセットのない安定したS字カーブ特性が得られる。

【0029】多分割回折素子19は2つの回折作用の異なる回折領域19a、19bが短冊形状に交互に並んだ形態のものを用いたが、本発明はこれに限定されるものではなく、多分割回折素子19は、図2(b)に示すように2つの回折作用の異なる回折領域19a、19bが格子状に細分化されてマトリクス状に並んだものでもよく、回折素子19に入射する反射光が対物レンズ12の移動により移動した場合でも、その移動領域をカバーし、かつ、常に2つの回折領域19a、19bに均一に入射し、2つの回折光22、23の光量が均一になるような分割形状であればよい。

【0030】また、受光素子20、21の受光領域分割パターンは、各回折光22、23のスポットサイズの差により光強度変化を検出できるものであればよい。さらに、受光素子20、21が各回折光22、23を別個に受光せずに回折光22、23を1つの受光素子で受光するようにしても構わない。また、図1に示す光ビックアップ装置では有田光学系を用いているが、図8に示すように集光素子としての対物レンズ12と回折素子19との間に光源10からの光束を平行光にするためのコーマーレンズ26を配置した無田光学系としても本発明は適用可能である。

【0031】光源10と受光素子20、21上の回折光スポット22S、23Sは、図1では同一面に配置されているように図示しているが、光ディスク13からの反射光が、回折領域19aによって受光素子の手前で集光し、かつ、回折領域19bによって受光素子の後側で集光するような配置であればよく、必ずしも同一面で集光する必要はない。

11

【0032】このように、受光素子20、21をトラッキング方向に平行な分割線で2分割することでトラッキングエラー信号検出が可能であり、また、回折素子19の回折領域を補正して反射光を回折させることで、トラッキング動作で対物レンズ12がトラッキング方向と直交する方向に移動した場合でも、フォーカスエラー信号に劣化やオフセットが生じず、常に安定したフォーカスエラー信号検出が可能となる。

【0033】以上のように、第1実施形態によれば、回折素子19は少なくとも集光素子としての対物レンズ12の移動に伴う反射光の移動範囲を捕う(含む)領域で複数の領域に分割された回折領域を持ち、回折素子19及び受光素子20、21は上記複数の領域のうちの一部及び受光素子20、21は上記複数の領域のうちの一部の方向で集光するとともに、上記複数の領域のうち他の一部の複数の領域19bで生じる+1次回折光が受光素子21の移動で集光するように配置され、受光素子として上記複数の領域で集光する回折光を受光する第1の受光素子20と、上記後側で集光する回折光を受光する第2の受光素子21とを備えて、上記スポットサイズ検出法によるフォーカスエラー信号検出を行い、上記回折光の軸を通過光情報記録媒体としての光ディスク13のトラッキング方向に平行な分割線で第1の受光素子20及び第2の受光素子21を2分割することでブッシュアップ法によるトラッキングエラー信号検出を行うので、トラッキングに伴う対物レンズの移動や光情報記録媒体のチャルトによらず、オフセットや劣化のないフォーカスエラー信号を得ることができ、良好で安定したフォーカスエラー信号を行うことができる。

【0034】上記第1実施形態において、図6に示すように、受光素子20上で回折光スポット22S(実際に図3に示すように多分割回折素子19により分割したものであるが、便宜上円形に表現してある)が移動した場合、受光素子20上のトラッキング方向に3分割した受光領域20a～20fのうち、最外側の受光領域20a、20d、20e、20fは反射光スポット22Sのグループ層による回折パターンに影響が少ないため、これらの最外側の受光領域20a、20d、20e、20fのうちラジアル方向に配列されている受光領域から得られる信号の差分をとることで、反射光スポット22Sの移動量に応じた信号を得ることができ、反射光スポット22Sの移動量に21については同様である。

【0035】これは受光素子21についても同様であるが、対物レンズ12の移動による反射光スポット22S、23Sの移動方向は図7に示すように受光素子20、21上では矢印のように互いに逆であるため、対物

12

レンズ12の移動もしくは光ディスク13のチャルトによる反射光スポット22S、23Sのズレ量を表わすスポットズレ信号は以下のようになる。

$$\text{スポットズレ信号} = (20a + 20c) - (20d + 20f) + (21d + 21f) - (21a + 21e)$$

ここで、図12は反射光スポット22S、23Sのズレ量(スポットズレ量)とトラッキングオフセット(トラッキングエラー信号のオフセット)との関係を示し、図13はスポットズレ量とスポットズレ信号との関係を示す。

10 これらの関係は両者ともほぼ比例関係にあるため、トラッキングオフセットとスポットズレ信号との関係も比例関係になる。よって、スポットズレ信号に定数kを掛けるとトラッキングオフセット補正信号を得ることができる。

【0036】そこで、本発明の第2実施形態では、上記第1実施形態において、図11に示すトラッキングエラー信号生成回路の代りに図14に示すようなトラッキングエラー信号生成回路が用いられ、受光素子20、21はそれぞれ、幅の狭い受光領域20b、20e、21b、21eと、広さの広い受光領域20a、20d、20c、20f、21a、21d、21c、21fとの少なくとも3つの受光領域に分割される。このトラッキングエラー信号生成回路は、上述のようにトラッキングエラー信号を演算する演算回路25と、スポットズレ信号を演算する演算回路27と、この演算回路27からのスポットズレ信号に係数をかけてトラッキングオフセット補正信号を得る係数器28と、演算回路25からのトラッキングエラー信号に対して係数器28からのトラッキングオフセット補正信号を減算して補正する演算回路29とからなり、受光素子20、21の各受光領域20a～20f、21a～21fからそれぞれ得られる信号20A～20F、21A～21Fを以下の演算式

$$\begin{aligned} \text{TES} &= (20a + 20b + 20c + 21d + 21e + 21f) - (20d + 20e + 20f + 21a + 21b + 21c) - k \{ (20a + 20c) - (20d + 20f) + (21d + 20f) - (21a + 21c) \} \end{aligned}$$

により演算することで、トラッキングエラー信号TESを生成する。

40 【0037】よって、受光素子20、21の分割数を増やすことなく簡単な回路を追加することで、対物レンズ12の移動や光ディスク13のチャルトによるトラッキングエラー信号を演算する演算回路27と、この演算回路27からのスポットズレ信号に係数kをかけてトラッキングオフセット補正信号を得る係数器28と、演算回路25からのスポットズレ信号に対して係数器28からのトラッキングエラー信号を減算して補正する演算回路29は、トラッキングオフセット補正回路を構成する。

50 【0038】このように、第2実施形態によれば、第1

14

割した受光領域20a～20c、21a～21cと、反射光スポット22S、23Sのグループ層による回折パターンのうちの0次光と±1次回折光が重なる領域内の一部分のみを受光する2つの受光領域32p、32q、33p、33qが設けられる。

【0043】フォーカスエラー信号生成回路は、図13ないし図14の回路からなり、受光領域20a～20c、21a～21cからそれぞれ得られる信号20A～20C、21A～21Cを以下の演算式

$$FES = (20A + 20C + 21B) - (20B + 21A + 21C)$$

により演算することで、スポットサイズ検出法によるフォーカスエラー信号検出を行ってフォーカスエラー信号TESを生成する。

【0044】トラッキングエラー信号生成回路は、演算回路34からなり、受光領域32p、32q、33p、33qからそれぞれ得られる信号32P、32Q、33P、33Qを以下の演算式

$$TES = (20P + 21Q) - (20Q + 21P)$$

により演算することで、ブッシュアップ法によるトラッキングエラー信号検出を行ってトラッキングエラー信号TESを生成する。

【0045】反射光スポット22S、23Sのグループ層による回折パターンのうちの0次光と±1次回折光が重なる領域の光強度は、その領域内ではほぼ一定である。よって、受光素子20、21の受光領域32p、32q、33p、33qが反射光スポット22S、23Sのグループ層による回折パターンのうちの0次光と±1次回折光が重なる領域内の一部分のみを受光するので、対物レンズ12のチャルトにより

30 回折光が重なる領域内の一部分のみを受光するので、対物レンズ12のチャルトにより反射光スポット22S、23Sがラジアル方向に移動した場合でも、受光領域32p、32q、33p、33qが反射光スポット22S、23Sのグループ層による回折パターンのうちの0次光と±1次回折光が重なる領域から外れない限りは、トラッキングオフセットの安定したトラッキングエラー検出が可能となる。

40 【0046】受光領域32p、32q、33p、33qは、図17では楕円形状で記されているが、必ずしも楕円形状である必要はなく、対物レンズ12のチャルトや光ディスク13のチャルトにより反射光スポット22S、23Sがラジアル方向に移動した場合でも、反射光スポット22S、23Sのグループ層による回折パターンのうちの0次光と±1次回折光が重なる領域を常に受光できる領域に設定されればよい。

【0047】このように、第4実施形態によれば、反射光の光ディスク13のグループ層による回折パターンのうちの0次光と±1次回折光が重なる領域の一部を受光する受光領域32p、32q、33p、33qを受光素子

える光ビックアップ装置を実現することが可能となる。

【0068】

【発明の効果】 以上のように請求項1に係る発明によれば、トラッキングに伴う集光素子の移動や光情報記録媒体のチャルトにより、オフセットや分化のないフォーカスエラー信号を得ることができ、良好で安定したフォーカスエラー信号を行うことができる。請求項2に係る発明によれば、受光素子の分割数を増やすことなく簡単な回路を追加することで、集光素子のソフトや光情報記録媒体のチャルトによるトラッキングオフセットを補正することができる。

【0069】 請求項3に係る発明によれば、トラッキングオフセット補正を行って行うことができ、ひいては安定したトラッキングエラー信号の検出が可能となる。請求項4に係る発明によれば、集光素子のソフトや光情報記録媒体のチャルトがあつた場合でもトラッキングオフセットのない常定したトラッキングエラー信号検出が可能となる。

【0070】 請求項5に係る発明によれば、集光素子のソフトや光情報記録媒体のチャルトがあつた場合でもトラッキングオフセットのない常定したトラッキングエラー信号検出が可能となる。請求項6に係る発明によれば、安定したトラッキングエラー信号検出を行うことが可能となる。

【0071】 請求項7に係る発明によれば、光利用効率が高く、受光素子の入射光量が減少してフレア光が少なくなり検出信号のS/Nが向上する。また、検出信号のS/Nを同程度にした場合や、光情報記録媒体の記録面に到達する光の強度を同程度にする場合は、光源のパワーをより少ないものにできる。

【0072】 請求項8に係る発明によれば、光情報記録媒体反射光の光利用効率を向上させ、S/Nの良い信号検出及びS/Nの良い光ビックアップ装置を簡単に低コストで実現できる。請求項9に係る発明によれば、外来ノイズの影響を受けにくく、受光素子の後段に回路を追加することなく安定した信号の生成及び情報記録再生を行える光ビックアップ装置を実現することが可能となる。

【図面の簡単な説明】

【図1】 本発明の第1実施形態を示す概略図である。
【図2】 同第1実施形態で用いられる多分回折素子の各例を示す平面図である。
【図3】 同第1実施形態における受光素子上での回折光の受光スポットを示す図である。
【図4】 同第1実施形態において対物レンズがトラッキング動作によりトラッキング方向と直交する方向に移動した場合の多分回折素子上での反射光の移動を示す平面図である。

【図5】 同第1実施形態で対物レンズを移動させた場合

のフォーカスエラー特性を示す特性図である。

【図6】 同第1実施形態において受光素子上での回折光スポットの移動を示す平面図である。

【図7】 同第1実施形態における対物レンズの移動による反射光スポットの移動を示す平面図である。

【図8】 本発明を適用した無限光学系を有する光ビックアップ装置の一例を示す概略図である。

【図9】 上記第1実施形態に用いられるフォーカスエラー信号生成回路の一例を示す回路図である。

【図10】 上記第1実施形態に用いられるフォーカスエラー信号生成回路の他の例を示す回路図である。

【図11】 上記第1実施形態のトラッキングエラー信号生成回路を示す回路図である。

【図12】 光ビックアップ装置における反射光スポットのズレ量とトラッキングオフセットとの関係を示す特性図である。

【図13】 光ビックアップ装置におけるスポットズレ量とスポットズレ信号との関係を示す特性図である。

【図14】 本発明の第2実施形態のトラッキングエラー信号生成回路を示す回路図である。

【図15】 本発明の第3実施形態における受光素子の受光状態を示す平面図である。

【図16】 本発明に用いることが可能な受光素子の一例を示す平面図である。

【図17】 本発明の第4実施形態におけるフォーカスエラー信号生成回路を示す回路図である。

【図18】 本発明の第5実施形態における回折素子を示す平面図である。

【図19】 同第5実施形態の受光素子及びトラッキングエラー信号生成回路を示す回路図である。

【図20】 本発明の第6実施形態を示す概略図である。

【図21】 同第6実施形態における光ディスクからの反射光の移動を示す概略図である。

【図22】 同第6実施形態の回折素子を示す平面図である。

【図23】 本発明の第6実施形態の受光素子及びトラッキングエラー信号生成回路を示す回路図である。

【図24】 本発明の第7実施形態を示す概略図である。

【図25】 従来の光ビックアップ装置の一例を示す概略図である。

【図26】 従来の光ビックアップ装置の他の例を示す概略図である。

【図27】 同光ビックアップ装置の回折素子を示す平面図である。

【図28】 同光ビックアップ装置の受光素子を示す平面図である。

【図29】 同光ビックアップ装置における対物レンズのラジアル方向移動を示す概略図である。

【図30】 同光ビックアップ装置において光ディスクがチャルトした場合を示す概略図である。

【図31】 同光ビックアップ装置において対物レンズをラジアル方向に移動させた場合の回折素子を示す平面図である。

【図32】 同光ビックアップ装置において対物レンズをラジアル方向に移動させる場合の受光素子の受光状態を示す平面図である。

【図33】 同光ビックアップ装置において光ディスクがチャルトした場合の受光素子の受光状態を示す平面図である。

【図34】 同光ビックアップ装置での対物レンズの移動によるFES特性の劣化の一例を示す図である。

【図35】 同光ビックアップ装置での対物レンズの移動によるFES特性の劣化の一例を示す図である。

【符号の説明】

10 光ビックアップ装置

11 対物レンズ

12 対物レンズ

13 光ディスク

14 回折素子

15 回折素子

16 回折素子

17 回折素子

18 回折素子

19 回折素子

20 回折素子

21 回折素子

22 回折素子

23 回折素子

24 回折素子

25 回折素子

26 回折素子

27 回折素子

28 回折素子

29 回折素子

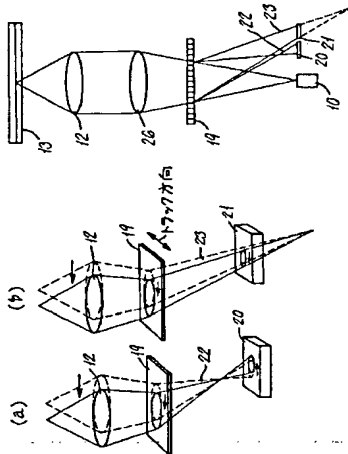
30 回折素子

31 0次光と±1次回折光が重なる領域

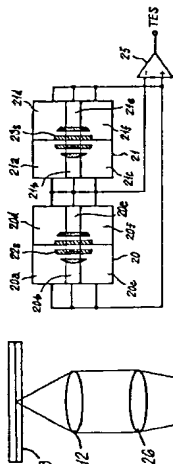
32 0次光と±1次回折光が重なる領域

33 0次光と±1次回折光が重なる領域

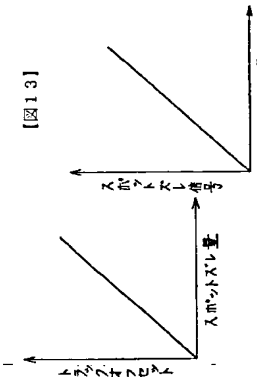
【図7】



【図8】



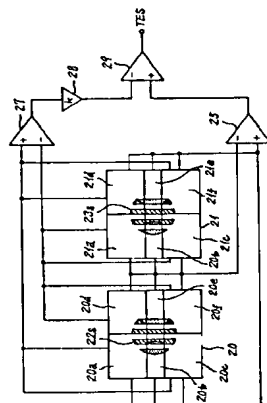
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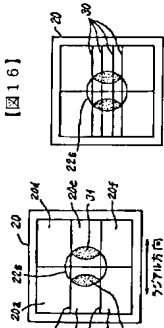
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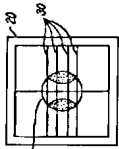
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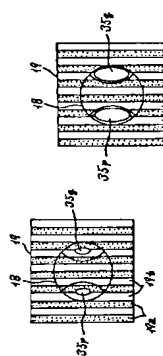
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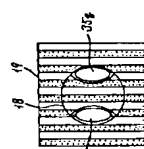
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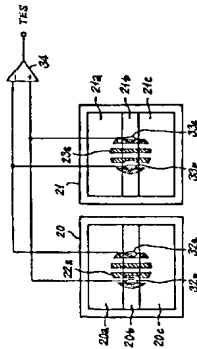
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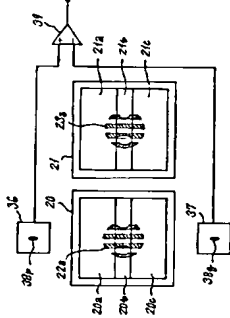
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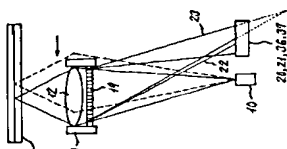
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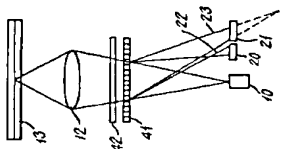
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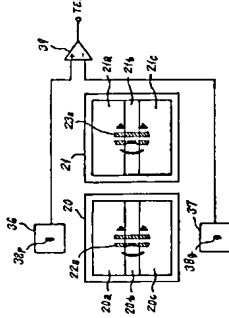
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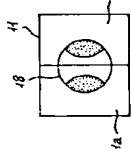
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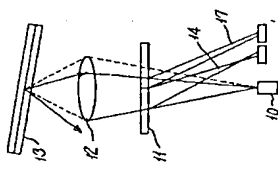
【図23】



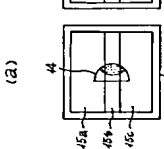
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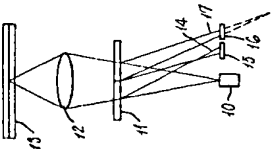
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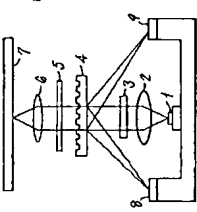
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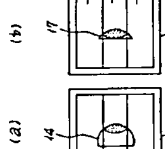
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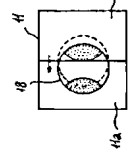
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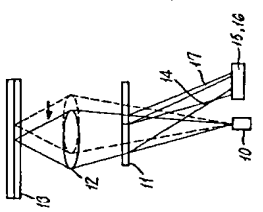
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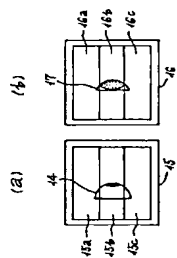
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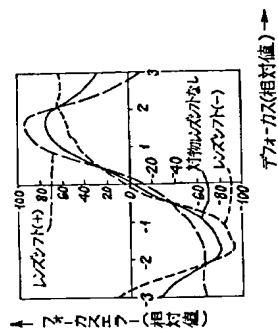
【図29】



【図33】



【図34】



【図35】

